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Introduction

The anatomy of the Lisfranc complex is well understood. In contrast, the lateral tarsometatarsal ligamentous structures are under investigated. A number of classifications have previously been proposed, noting homolateral and divergent subtypes of midfoot fracture dislocations.^{1,2} These subtypes indicate intact metatarsal connections of the middle and lateral rays (as illustrated clinically in figure 1), however little is understood in regards to these connections.

Aims

There are currently no anatomical studies analysing the middle to lateral plantar ligamentous insertions. Our aim was to identify the plantar ligamentous structures of the lateral tarsometatarsal joints and their significance in tarso-metatarsal joint injuries.

Methods

This study was completed following the receiving of a grant from BOFAS. We examined 10 cadaveric lower limbs that had been preserved for dissection at the Human Anatomy and Resource Centre at Liverpool University, in a solution of formaldehyde. The lower limbs were carefully dissected to identify the plantar aspect of the transverse metatarsal arch.



Figure 1 – Oblique radiographs pre and post op, following a fracture dislocation of the 3rd, 4th and 5th tarsometatarsal joints. Following reduction and fixation of the 3rd metatarsal, the 4th and 5th metatarsal positions normalise due to their plantar ligamentous connections.

Results

- In all specimens, the short plantar ligament blended with a transverse metatarsal ligament (lateral Lisfranc) spanning from the 2nd to the 5th metatarsal (as illustrated in figure 4).
- The separate short plantar ligament formed the floor of the peroneus longus canal (figure 4).
- The transverse metatarsal ligament formed the basis of the roof and distal aspect of the peroneus longus canal (figure 5 and 6). In addition, separate intermetatarsal ligaments were identifiable connecting each metatarsal.
- The short plantar ligament provides connects through the transverse metatarsal ligament, connecting the transverse and longitudinal arches of the foot.

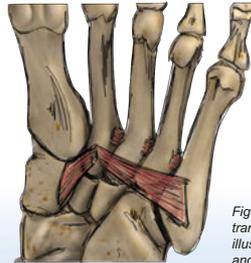


Figure 2 (left) – Illustration showing the skeletal anatomy of the plantar aspect of the foot with pictorial representation of the Lisfranc ligament, lateral Lisfranc ligament and the intermetatarsal ligaments.



Figure 3 (above) – Illustration showing the cross section of the transverse metatarsal arch at the base of the metatarsals illustrating the cross section of the intermetatarsal ligaments and lateral Lisfranc ligament.

Conclusion

- The plantar ligamentous structures of the lateral tarsometatarsal joints are a combination of individual intermetatarsal ligaments and a transverse metatarsal ligament (Lateral Lisfranc).
- This explains the homogenous nature of a divergent tarsometatarsal joint injury and why middle and lateral columns move as one.
- The lateral Lisfranc ligament acts like a suspension bridge, storing energy during stance phase that could be released during propulsive phase.



Figure 4 (left) – Superficial cadaveric dissection illustrating the short plantar ligament transverse from the calcaneum, over the peroneus longus canal to the lesser metatarsal bases.

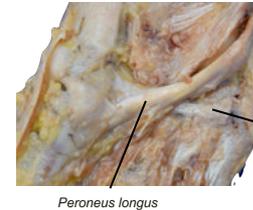


Figure 5 – Cadaveric dissection illustrating the short plantar ligament being removed, showing the peroneus longus tendon as it travels from lateral to medial, to insert on to the 1st metatarsal base. In this dissection the Lateral Lisfranc ligament is visible below the tendon.

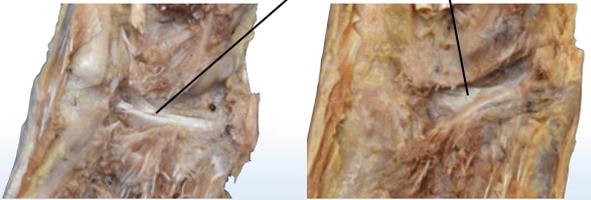


Figure 6a (above left) and 6b (above right) – Cadaveric dissection of 2 specimens illustrating the short plantar ligament and peroneus longus tendon being removed, showing the transverse metatarsal (lateral Lisfranc) ligament transverse from the 2nd metatarsal to the 5th metatarsal.

- This study has clinical significance in the observation that in some cases, lateral column instability can be overcome when the middle column is stabilised (figure 1).

References

1. Myerson MS et al. Fracture dislocations of the tarsometatarsal joints: end results correlated with pathology and treatment. Foot Ankle 1986;6(5):225-42.
2. Hardcastle PH et al. Injuries to the tarsometatarsal joint. Incidence, classification and treatment. JBJS Br 1982;64(3):349-56